

Learning From the Bat How to Make Airplanes Safe

By Applying to Airships the Same Principle That Enables Bats to Fly in the Dark As Safely As If There Were Firefly Traffic "Cops" to Guide Them, Science Hopes to Free Air Travel from the Danger of Collisions



Greatly Enlarged View of a Bat with One of Its Wings Outspread to Show the Network of Nerves Which Help the Little Creature to Produce Faint Sounds and to Respond So Promptly to Their Warning Echoes.



the Same Principle That Enables Bats to Fly in the Dark Without Risk of Collision. And on the Left—A Bat's Large Ear and the Curious "Air Shield" on Its Nose, Which Helps It to Hear the Faint Echoes Reflected by Obstacles in the Course of Its Flight.

SCIENCE believes it has found a way of safeguarding airplanes and dirigibles against collision—of making it practically impossible for them to run into one another or to crash into buildings, mountain peaks and other things, as they have so often done with such disastrous results.

The discovery which promises to relieve travel through the air of one of its greatest perils is the result of the long, patient study which scientists have been making of that curious and until now little understood creature, the bat.

Few things have ever puzzled science more than the amazing way bats fly at lightning speed through the pitch blackness of night or the gloom of darkened rooms or underground caves without once bumping into one another or into any of the various objects that loom up around them.

The bodies of bats are such delicate things and they dart about with such rapidity, turning abruptly without the slightest slackening of speed, that collisions would be full of serious consequences for them. Even the grazing of a bat's membranous wing by the wing of another speeding bat would injure them both severely, and to crash headlong into anything so unyielding as a telephone wire or the wall of a cave or church belfry—that would be pretty sure to be fatal to one of the little creatures.

But the observations of scientists show that bats seldom if ever meet with these collisions. They speed through the darkness with as little risk to themselves as if a firefly traffic cop hovered at every dangerous turn to guide them on their way in perfect safety.

The method which nature has devised to save bats from the dangers of collision is an ingenious and extremely effective one. Exactly the same principle can, it is believed, be applied to the protection of airplanes, dirigibles and other aircraft from similar dangers, and aeronautical experts, both in this country and in England, are now working toward this end.

When all airships are equipped with the ingenious devices that are being modelled on the lines suggested by a study of bats they will be able to avoid obstacles under all sorts of conditions—flying at night or through dense fog or steam clouds—with just as great ease and certainty as the bats do.

It used to be thought that the eyes of bats, blind under the conditions which enable other animals to see their best, possessed some strange power which could pierce the darkness and enable them to distinguish objects that would be entirely invisible to ordinary eyes. But it has now

been found that the immunity of bats from collisions as they dart swiftly through the darkness has nothing whatever to do with their eyes.

The secret of the ease and safety with which bats find their way around in the dark lies in the way their ears are attuned to catch the echoes of sounds produced by their wings and other parts of their bodies.

As the bat flies about it is continually emitting tiny sound waves too high to be audible to the human ear; but of just the right pitch to make an impression on its own peculiarly adjusted ears. Ordinary sounds, such as dogs and other animals readily detect, are wholly inaudible to the bat, but it hears even the faintest echoes of the sounds made by its own body. And these sounds and their echoes are, science believes, probably audible only to bats.

When the bat draws near some obstacle the sound waves produced by its body, travelling on ahead and striking the wire or wall or whatever it may be that bars the way, are reflected back to the bat's ears in the form of tiny echoes.

From the nature of these echoes the bat is able instantly to judge the nature of the danger that lies ahead and its distance away, and it shifts the course of its flight accordingly. The echoes of the sounds made by its own body stir the bat to suitable action of one kind or another, just as the sound of the traffic policeman's whistle in a busy city street does the motorist.

Now science is confident that it can equip the wings of aeroplanes and the envelopes of dirigible balloons with instruments which will duplicate, on an immensely larger scale, the sound-making powers that insure the bats against harm.

These sounds will travel ahead of the airship as it speeds through the darkness of night or the thick blanket of a fog or rain cloud. When these sounds are intercepted by some obstacle—another aircraft, the side of a mountain, a towering skyscraper or church steeple—their echoes

Accidents Like This Can Easily Be Avoided When Science Applies to Aeroplanes



Science Believes the Amazing Way Blind Persons Avoid Running Into Walls, Trees or Lampposts May Be Due to Their Acquiring the Power to Hear Echoes Similar to Those Which Guide Bats in Their Flight and Which Are Now to Be Utilized to Safeguard Aeroplanes Against Collision.

will be reflected back to a receiving instrument placed before the pilot's eyes.

Just as the bat directs its flight according to the nature of the echoes reaching its ears, so the airship pilot will steer his course in safety in accordance with the nature of the echoes recorded by the receiving instrument in front of him.

When all aircraft are equipped with these sound-emitting and echo-receiving devices one of the greatest hazards of aviation will have been removed. The world will then owe a great debt indeed to the

once despised bat and to the scientists who have at last wrested from this curious little winged mammal the secret of its marvellous ability to avoid disastrous collisions while flying in the dark.

The way the learned professors at Cambridge University, England, cleared up the mystery of the bat's darting flight through the darkness is extremely interesting and a good example of the patient, painstaking lengths to which science often goes in its efforts to make discoveries of the greatest benefit to mankind.

Head of Blainville's Bat Which Has a More Highly Developed Apparatus Than Any Other Bat for Hearing Sounds Inaudible to Man. The Large, Sensitive Outer Ears, the Three-Leaved Formation in the Centre and the "Hearing Posts" on the Nose and Chin All Play Their Part in Its Extraordinary Hearing.

Night after night the scientists studied the behavior of the bats which flew in hundreds through the windows of one of the ancient university buildings. They soon observed that when the lights were turned off the bats never flew against the globes or other fittings, even when there was a steady stream of them passing rapidly through the room. When threads were stretched across the darkened room the bats always dodged them with unerring accuracy. Other tests showed that the little creatures were able to tell whether a door was shut or opened wide, or opened just enough to allow them to pass through.

Still other experiments revealed the surprising fact that even when a bat's eyes were covered with wax it could avoid obstacles placed in the room, such as threads or a dozen chairs placed irregularly. The bats never even grazed these obstacles with the tips of their wings.

It was also observed that the bats never dashed themselves uselessly against the window panes, as many other birds and insects do. This showed that their peculiar senses told them that the invisible glass was in their way.

All these experiments showed conclusively that the bat's unusual powers are not due to keen eyesight, for they could "see" in absolute darkness. Their eyes were only partially developed and they could "see" with their eyes covered. Nor was their power of flying about without colliding with one another or with the things around them due to their keenness of touch, for it was not brought into play.

It was not reasonable to assume that the bat's powers were due to keenness of hearing, because for most sounds their ears proved less acute than those of dogs and other animals. It was not scientific to assume that they had a sixth sense not understood by man and not possessed by other animals.

Still more intricate experiments showed

that the bats gave forth when flying little noises, or what science calls "short wave-length sounds." These sounds are quite near the audible limit of man's ears and above that of most people. The bats, it was found, are abnormally sensitive to such sounds and have little or no ability to hear louder sounds.

It was discovered that bats were not at all disturbed when some of the investigators spoke loudly to them, but that they did become greatly excited when paper was torn or hands clapped. The explanation of this was that man's speech was below their hearing limit, while the noise of tearing paper or handclapping is within their hearing range and disturbs the acuteness of the sense that is directing their flight.

As most people know, bats move their wings very rapidly, making about ten or twelve strokes with them every second. This motion was found to produce an extremely high note that is not generally audible to man, but easily becomes so with the aid of a microphone.

This high note travels after the manner of sound or, perhaps, of light, strikes all the surrounding objects, becomes modified by their character and size, and is reflected back in the form of echoes which are received by the bat's ears.

There is a possibility that some of these inaudible sounds which enable the bat to steer its course in the dark so successfully come from the little creature's throat, but this has not yet been proved. There is, however, a variety of evidence to establish the fact that the bat receives its knowledge of surrounding objects by sending out certain sounds that are reflected back to its ears a moment later.

The outermost parts of a bat's ears are very large, movable, sensitive and well developed. They are furnished with nerves and blood vessels in a higher degree, proportionately, than the outer ears of other animals. They move and quiver in a strange manner which was never understood until the present investigations made its purpose quite clear.

In front of the openings of the ears are little upright pieces of tissue and cartilage which also move above in a very puzzling manner. These give additional help in catching sounds that are inaudible to human ears. Besides these little "hearing posts" some peculiar species of bats have a series of facial appendages which are connected with the "leaves" in front of the ears and which help in the matter of hearing.

The faces of certain species of bats are covered with little organs, which cooperate in their extraordinary hearing powers. In the large vampire bat there is an organ on the tip of the nose. It stands up in the air and is called "the shield," but in most of the small bats that catch insects on the wing we find the two little "leaves" in front of the ear openings, not unlike the wings of the insects that it pursues. Others have additional sensitive spots located around the sides of the face, the cheeks, chin and lips.

Since the discovery of the way bats "see" by emitting little sounds and then listening to the echoes reflected by them when they come in contact with various objects, science is wondering whether some similar adaptation of the human body may not explain the amazing way blind people avoid running into things.

With the loss of their sight it is thought that perhaps their bodies acquire the power of emitting certain faint sounds, just as the bats do. The ears of the blind catch the echoes which these sounds produce when they are reflected by a wall, a lamppost or some other obstacle, and thus they are able to avoid frequent collisions in the uncanny way with which everybody who has ever watched a sightless person walking about is familiar.